METAL INDUSTRY

16 MAY 1958

D.S.I.R.

DURING the forty-two years existence of the Department of Scientific and Industrial Research pure and applied science have made enormous strides in industry and the universities. Industries based on science have grown to maturity and prospered and entirely new industries have emerged as a result of technological change. Industry has become the largest employer of research workers and an increasing amount of research work must be organized on a large scale by integrated teams of specialists supported by great resources. For these reasons the Council for Scientific and Industrial Research has deemed it necessary to re-assess the main function of the D.S.I.R. and to decide what changes, if any, there should be in policy and organization. The results of its deliberations were published last week in the Annual Report for 1956-57.

With regard to pure research the Council states that while the universities are, and will continue to be, the main centres of pure research and that while every care must be taken to ensure that full use is made of the potential research capacity of university staff, the D.S.I.R. has an important part to play and its expenditure on this activity must rise considerably. In this connection it may be noted that grants for pure research in 1956-57 were over double those for the previous year.

The second question discussed is "what part should D.S.I.R. Stations play in research of direct application to industry?" Investigations on this subject are not yet completed, but the Council is of the opinion that there is a large and growing field of activity in which the Government has a direct interest and a special responsibility, and in which, therefore, the research work required is appropriate to a national research establishment. In order to undertake new responsibilities, however, it is necessary to shed some of the existing load. Some action has already been taken in this respect in connection with the Forest Products Research Laboratory and the Low Temperature Research Station. A further step is that the Fuel Research Station will be closed early in 1959, but the work and function of the National Physical Laboratory, the Chemical Research Laboratory and the Mechanical Engineering Research Laboratory are still under review. The changes implemented or envisaged will bring about a redistribution of effort between the stations and other research organizations in line with the modern function of the Department and also free them for a greater volume of important pioneering work.

On the question of the allocation of resources to avoid spreading them over too wide a field, the Council expresses grave doubts of the adequacy of its resources for all that it is charged to do. This, it will be remembered, embraces not only the undertaking and support of both pure and applied research to meet the needs of industry and the civil needs of Government, but also the provision of grants for training scientists and technologists and for helping British academic research maintain its world position. It is pointed out that in those industries which do not benefit directly from research done primarily for defence purposes, the value of production approaches £10,000 million a year. By contrast, the Department is spending less than £10 million a year for *all* its activities.

Of particular interest to the non-ferrous metal industry is the fact that the Council is investigating to what extent industries served by the grant-aided research associations can be expected to shoulder the whole financial burden of an adequate research programme, either now or in the near future. As a first stage in this investigation the Industrial Grants Committee has been surveying both the value of the work of the research associations and the methods used to assess and administer the Government grant. In the light of this survey, Government grant policy in relation to research associations is to be reviewed during the coming year.

Out of the MELTING POT

With Care CAREFUL investigations and the discovery of one essential step, have altered the proposition of brazing aluminium alloy castings from something that was impossible to something that, although it calls for a little painstaking attention, can be done. The impossibility of brazing aluminium alloy castings arose from the proximity of the brazing temperature to the temperature of incipient fusion of most of the common aluminium casting alloys. The procedure by which this snag can be avoided involves a preliminary solution heat-treatment of the casting. The latter should consist of an aluminium alloy containing 5 to 15 (preferably 5 to 10) per cent silicon and 0·1 to 3 (preferably 0·25 to 0·6) per cent magnesium. The heat-treatment required comprises heating to a temperature of between 940° and 1,010°F. for a period of 5 hr. to 15 hr.; long enough to bring about substantially complete solution of the soluble alloy constituents. The heating is followed by quenching of the castings to a temperature below the boiling point of water. The heat-treated casting, with one or more other components, which may include similarly treated castings or wrought products, are then assembled in the usual way with brazing flux and filler metal. The latter should be an aluminium alloy containing 10 to 13 per cent silicon and 2·5 to 4·5 per cent copper with, optionally, 6 to 16 per cent zinc. The assembly is then furnace brazed at a temperature between 1,030° and 1,060°F., or by local heating with a torch. To retain the mechanical properties developed in the casting by the initial heat-treatment, the brazed joint and the adjacent region should be cooled to a temperature between 940° and 1,010°F., or, if furnace brazing has been used, the whole assembly should be allowed to cool to this temperature either inside or outside the furnace and then quenched, preferably in hot water. Finally, if desired, the assembly may be subsequently artificially aged in the usual way, i.e. at 300° to 500°F. for 2 hr. to 12 hr.

Superfluous CONTINUING acquaintance with the efforts of enthusiasts for "applications for every material, and every material for its appropriate applications" tends to leave one with the impression that such efforts amount to no more than the flogging of an imaginary horse. This is probably just as well for the horse, since the progress it could make, if real, is problematical. Extricating oneself from this rather involved metaphor and reverting to applications of available materials, the point at issue can be put in another way by asking, how many actual applications of particular materials represent the outcome of an *a priori* search for the right material guided by the relevant data for all possible materials? The answer to this question is likely to be: Very few, if any. In most cases, applications result from a search for applications for a given material rather than for materials for a given application. In fact, some applications would have been very difficult to imagine otherwise than by starting from a given material and its particular properties. In those cases in which an application does happen to be envisaged first, it usually has to wait some considerable time before the right material comes along, not as a result of being chosen but as a result, more often, of being developed. Applications still waiting for the development of materials that would make them possible are not unfamiliar. The situation can probably be summed up best by saying that it is one of the few in which generalization does not pay. Lists of materials and their properties are very little use from the point of view of possible applications. What is needed is specialization: concentration on one material and the exercise of imagination to visualize possible applications for it. Regarding a particular material as the egg and an application of it as the chicken, there can be no doubt as to the need, in this particular instance, for the egg to precede the chicken.

Say What A REALLY wide choice, though it may be puzzling, is undoubtedly stimulating. Puzzling and stimulating are adjectives that can certainly be applied to the following list of organic compounds: melamine, melamine cyanurate, ammeline, ammelide, ammeline: ammelide compound, melam, melem, melon, cyanuric acid, and guanamines such as stearoguanamine. This list may become a little less puzzling when the explanation is provided that the above are all derivatives of the heterocyclic triazine group. The stimulus should develop on learning that these compounds have been claimed to be particularly suitable for use as lubricating additives to metal powders to be used in powder metallurgy. Finally, the breadth of the choice offered by the above list of representative triazine additives will become apparent when one recalls that, hitherto, lubricating additives to metal powders have been substantially restricted to stearates, if one excepts graphite with its incidental lubricating action in mixtures for the manufacture of finished products intended to contain graphite. The amount of triazine derivative added may range from 0·25 to 5 per cent by weight of the metal powder, the best results being obtained when a major proportion of the triazine compound is in the particle size range of about 0·05-15·0 microns, and preferably 0·1-5·0 microns. The choice of compound to be used is guided by the effects it is desired to secure through its use. Thus, for example, while ammeline and melamine do not affect the flow rate of a metal powder, they do increase the green density of the compact, the melamine being more effective in this respect in the case of fine powders, while ammeline is better for use with coarse metal powders. Stearoguanamine is excellent from the point of view of ejection pressure and the final appearance of the sintered compact. Melon has the property of being stable at red heat. Melon has some similarity with graphite so far as lubricating properties are concerned, and can with advantage be applied to the walls of the die cavity. The melting point of the additive chosen should be above the temperature reached when the powder is being compacted. Strictly speaking, these compounds do not possess true melting points and simply evaporate during sintering. Finally, for some purposes, e.g. to reduce the ejection pressure, it may prove desirable to mix one of these triazine additives with a stearate soap lubricant.

Skimmer

Institute of Metals Jubilee Meeting

J. Stone and Company (Charlton) Ltd.

By R. J. M. PAYNE, B.Sc., F.I.M.

(Concluded from METAL INDUSTRY, *9 May* 1958)

THE magnesium and aluminium sand foundries are housed, together with facilities for fettling, heat-treatment, inspection, etc., under a single roof, the total floor area amounting to 90,450 ft^2. The buildings are in four bays and these adjoin the administrative block, in which are also found the X-ray inspection department and test house.

All currently-used magnesium-base and aluminium-base alloys are handled in these foundries, including the high-strength, creep-resistant and other special purpose compositions: the complex aluminium-base proprietary alloys "Ceralumin" fall within this latter group. Production capacity is supplemented in the case of aluminium castings by a further 16,700 ft^2 in a foundry operated by the company at Gravesend. Castings range in size from the smallest up to 750 lb. fettled weight in magnesium, and up to 2 tons fettled weight in aluminium.

Assembly of mould and cores for a large aluminium engine crankcase

Melting facilities for magnesium include two furnaces holding crucibles of 600 lb. capacity, but the bulk of the melting is done in 300 lb. crucibles. All furnaces are oil-fired and served by crane for lift-out purposes. Pyrometer gear is provided at appropriate points. Melting procedure for magnesium is on familiar and well-established lines, using the fluxes and alloying materials supplied by Magnesium Elektron Limited. A special feature of this foundry is the attention directed towards the control of grain size in magnesium-zirconium alloys, a grain count being carried out on a sample of metal taken from each crucible before pouring. A special laboratory with the necessary polishing equipment and microscopes is placed close to the magnesium melting shop for this purpose.

Large gear casing for a helicopter in magnesium alloy "RZ 5" being tested for cracks in "Ardrox" solution. Fettled weight of casting 450 lb.

The floor moulding and machine moulding areas are served by August sand mills. Prior to reconditioning in these mills, the sand, which is of the synthetic type bonded with Bentonite, and containing sulphur and boric acid inhibitors, passes through a Marco rotary screen and separator. Moulding machines in their various sizes are of Coleman-Wallwork manufacture.

Cores for both magnesium and aluminium foundries are made in separate core shops located at the ends of the foundry bays. The core shops are equipped with the usual sand driers, mixers and core drying stoves, including two of the Acme vertical type. Most of the core-making benches are piped for carbon dioxide for the manufacture of cores by the CO_2 process. Special attention has been paid to ventilation and fume extraction in laying out these foundries.

In the aluminium foundry, furnaces are in units of 400 lb. and 200 lb. melting capacity. Gas testing by the Straube-Pfeiffer method has been made a matter of routine, and separate furnaces are provided for melting aluminium-magnesium alloys of the "L.53" type.

The greater proportion of the total space is devoted to floor moulding, and some large castings, exemplified by the crankcase for the Napier "Deltic" engine are in regular production.

Removal of heads and flash from an aluminium motor-cycle cylinder head

Moulding machines are again of Coleman-Wallwork manufacture, and include one exceptionally large 72 in. by 48 in. machine which is served by a sand slinger. The main sand mill and conveyor in the aluminium foundry is by Foundry Equipment Limited. A "Floatex" shake-out is provided at the knock-out point.

Both the magnesium and aluminium foundry are served by well-equipped fettling shops, a notable machine being the large horizontal Midsaw used for removing the feeder heads from engine crankcases and other similar parts. Two grit blasting cabinets of the conventional type and one Tilghman Wheelabrator are available for cleaning purposes.

The products of both light alloy sand foundries and of the die-casting foundry are heat-treated in a common heat-treatment department. This is equipped with two Efco electric resistance heated air circulating furnaces, 4 ft 6 in. diameter by 6 ft. deep, four smaller furnaces, 4 ft. diameter by 6 ft. deep, and a further furnace for small batches of castings 3 ft. diameter by 4 ft. deep. Carbon dioxide provides the necessary inert atmosphere for the heat-treatment of magnesium castings at high (solution) temperatures, and flow meters are placed, together with the electrical control instruments, within a separate and enclosed control cubicle. For stress relieving and for precipitation treatments, two furnaces by Controlled Heat and Air Limited, sizes 13 ft. 6 in. by 6 ft. by 5 ft. and 8 ft. by 5 ft. by 3 ft., are available. A centrally placed quench tank and overhead crane for the manipulation of furnace cradles are provided.

Die-Casting Foundries

These foundries make gravity die-castings in the yellow metals (brasses, high-tensile brasses, aluminium and special bronzes), in a range of aluminium-base alloys and in magnesium-base alloys. No pressure die-casting is carried out at Charlton, but pressure die-castings are made in magnesium alloy by an associated company, Stone-Fry Magnesium Ltd., at Merton Abbey, London, S.W.19.

With castings destined for all branches of the engineering industry, the work undertaken shows, as would be expected, great variety in type and design—a feature common to most gravity die-casting foundries. Variations in size and weight are probably most marked in aluminium castings, which vary from around 1 oz. to 100 lb. or more. Motor cycle cylinder heads and wheel hubs, oil sumps for heavy motor vehicles, warp beam flanges for the textile industry, pallets for tile-making, gas turbine engine starters, and food mixers illustrate the diversity of products made.

The alloy compositions used, apart from proprietary copper-base and aluminium-base alloys are those conventionally used for die-casting.

The die-casting foundries, with their associated inspection department and toolroom, occupy a total space of 24,200 ft^2. Melting is carried out in oil-fired Morgan furnaces, these being of the bale-out type for copper-base and aluminium-base alloys and of the tilting variety for magnesium. The furnaces are set out in a well-arranged and well-ventilated shop. In general, casting runs do not justify the introduction of a high degree of mechanization, but such mechanical handling aids as can be employed without impairing flexibility are used in the foundries. Thus, air-operated lifts or electrically-operated tackles are provided at all stations where heavy dies are being handled. The die-casting foundries are backed by a well-equipped toolroom for die manufacture and are provided with the usual facilities for fettling.

X-ray Department

A considerable proportion of the total casting production from the light alloy sand foundries is supplied to the aircraft industry, and includes many engine and airframe components (e.g. compressor casings, windscreen and hatch framings) of large size. The greater number of these castings falls

Radiography of a large Volute casting in aluminium alloy using 250 kVp X-ray equipment

within those categories for which radiological inspection is obligatory. To a smaller extent, radiological inspection is mandatory for light alloy die-castings and for castings in the heavy metals, as at the present time these find their greatest use in non-aircraft fields. Even where it is not a condition of acceptance, radiography is, however, used freely in developing foundry techniques and as a safeguard against trouble being revealed on machining. All told, this amounts to a heavy burden of non-destructive testing, made even heavier by the increasingly wide use made of dye-penetrant methods of crack detection.

Facilities for non-destructive testing, probably the most extensive in the country, are housed in the administrative block and comprise one X-ray set operating at 250 kVp maximum, one at 220 kVp maximum, and seven at 140 kVp maximum. Cobalt 60 (3 curies) and Caesium 137 (2 curies) isotope sources supplement the X-ray sets and provide the more penetrating gamma rays suitable for the examination of heavy metal castings. These sources are, for reasons of safety, kept and used in a fenced-off enclosure in an unfrequented part of the works. The very considerable amount of X-ray film arising from the use of this equipment is processed in a fully automatic plant of the company's own design and manufacture. The usual viewing lanterns are provided for purposes of interpretation, together with a 200 ton hydraulic press for destructive testing where this is necessary or desirable.

Crack testing is carried out using "Ardrox" materials in tanks, each holding 500 gals. of solution: these are necessary to accommodate the large castings which have to be dealt with. Non-destructive testing takes up a total floor space of 7,700 ft^2.

Metallurgical Department

The company carries a technical staff appropriate to its many commitments in regard to production and research. This ensures that informed guidance is available to its own foundries in connection with the control of those materials and processes on which production is based, and furthermore, enables the company to provide a metallurgical service to other companies in the Group and to their own customers. Stone's have also for many years conducted research on cast and wrought non-ferrous alloys with a view to establishing improved materials, and the copper-manganese - aluminium ("Superston" and "Novoston") alloys, already referred to, are examples of the outcome of such research: other examples are to be seen in Stone's "Ceralumin" alloys and in some (non-proprietary) creep-resistant and high-strength magnesium alloys in general use in foundries.

The spacing between the various foundries is such that a concentration of all technical personnel in a single building would be unsatisfactory: the metallurgical research laboratories and analytical laboratories are, however, housed in a separate and well-equipped two-storey building.

Works Visits

Northern Aluminium Company Ltd: Banbury

(Concluded from Metal Industry, 9 *May* 1958)

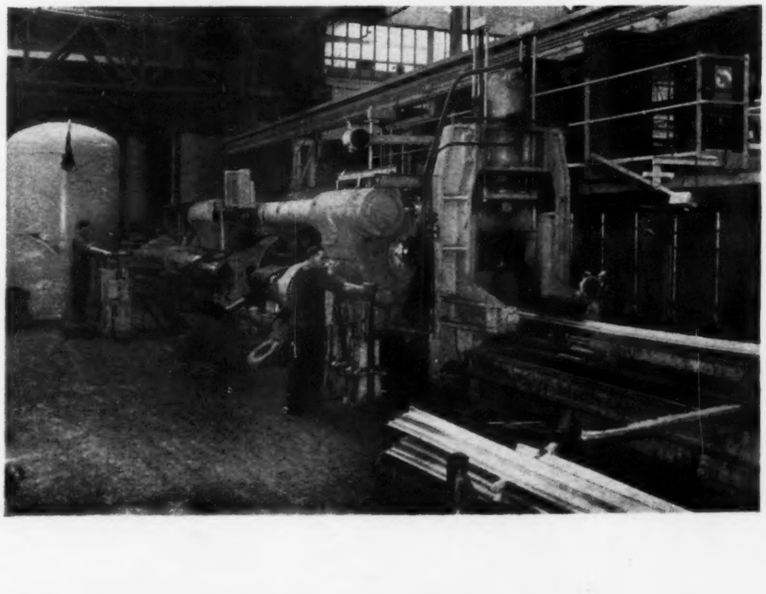
EXTRUSION facilities at Northern Aluminium Company's Banbury works supplement those at the Rogerstone works, where there are ten presses, all laid down during the war, including one rated at 8,000 tons, which produces the more massive sections required for aircraft spars and the like.

Banbury's first extrusion press, of 750 tons, was installed in 1936 on removal from the company's West Bromwich works, where it was used, as it is to-day, for small sections in the "common" alloys, chiefly decorative trim. At the same time, a new press of 2,000 ton rating was installed.

In 1939, when rearmament was creating a great demand for strong-alloy sections for aircraft, two other presses, of 3,500 and 5,000 tons, were laid down (by Schloemann, as were the others). These four presses, which are hydraulically operated, are in use to-day, extruding a very great variety of sections for almost every field of industry. Although the major equipment has thus remained the same over 20 years, extrusion technique has advanced; for example, the porthole method of extrusion, dispensing with the long mandrel, which was one of the most noteworthy innovations many years ago, has been developed to produce hollow sections of a complexity only recently possible.

Since the installation of the last two presses and an increasing amount of ancillary equipment, there has been less floor space than could be desired for the movement and stacking of sections. This has, in some measure, increased the speed of handling by encouraging the careful siting of subsidiary equipment. Speed and economy of operation are especially marked where extrusions that can be "quenched at the die" (this giving them a solution treatment) are stretched and cut to length beside the run-out tables. To facilitate, and speed up, the handling of sections down the table as they emerge from the die, a mechanical dragline has been installed over the table of the 750-ton press. As would be expected, although the diameter of the container on this press is necessarily much smaller than on any of the others, the section produced is also of less than average size and it is, therefore, not uncommon for half-a-dozen to be

Banbury's largest extrusion press, of 5,000-ton rating, produces 'heavy' sections for aircraft and other industries



Part of the extrusion department, showing in the background the 3,500-ton and 5,000-ton presses

extruded simultaneously, which makes handling by the usual method somewhat slow and awkward.

The billets for extrusion are preheated in either a gas-fired or electrically-heated furnace installed alongside the press. The extruded sections in the heat-treatable alloys that have not already been quenched at the die are solution-treated in a vertical gas-fired furnace or a horizontal electric furnace situated in the extrusion bay, and horizontal furnaces are also available for precipitation treatment.

The third main production department is the paste plant, where pigment is manufactured for aluminium paints and printing inks. The paste is exported in large quantities, as well as commanding a large home market, and a proportion of the intermediate product, aluminium powder, is sold for explosives.

The powder is produced by atomizing molten aluminium of 99·5 per cent purity: hot compressed air forced vertically through a nozzle draws the metal, held at the correct temperature in a reverberatory-type furnace, through a central orifice, and the granulated powder that is formed is drawn by a fan into two large vertical towers or "cyclones," which effect a separation according to particle size. The complete unit of atomizer and cyclones is laid down in duplicate.

After a screening process, the powder, of a size determined by the grade of paste that is to be produced, is charged into a ball mill together with white spirit and stearic acid. Here, the hammering action of the steel balls reduces the powder to minute flat, flake-like particles, the stearic acid acting as a lubricant and coating each flake with a film that will give the paste its most important characteristic. This is its ability to "leaf," or for the flakes to arrange themselves in overlapping layers at the surface of the medium, providing in effect an armour of metallic aluminium to protect any surface on which the paint is applied. Different grades of paste are produced by varying the amount of powder charged to the mill and the milling time.

At the completion of milling, the sludge is filtered under pressure and fresh additions of white spirit made to the filter cake to adjust it to the required metal content. It is then packed in metal drums.

In the manufacture of "Alpaste," to give the name under which the company markets the paste, it is absolutely essential that each stage of the process is minutely controlled and a careful check kept on the product at each stage; small divergencies could produce inferior material, which would probably be identified, in use, by its inferior brilliance.

Quality control is, however, exercised at all stages of production of each of the commodities produced by

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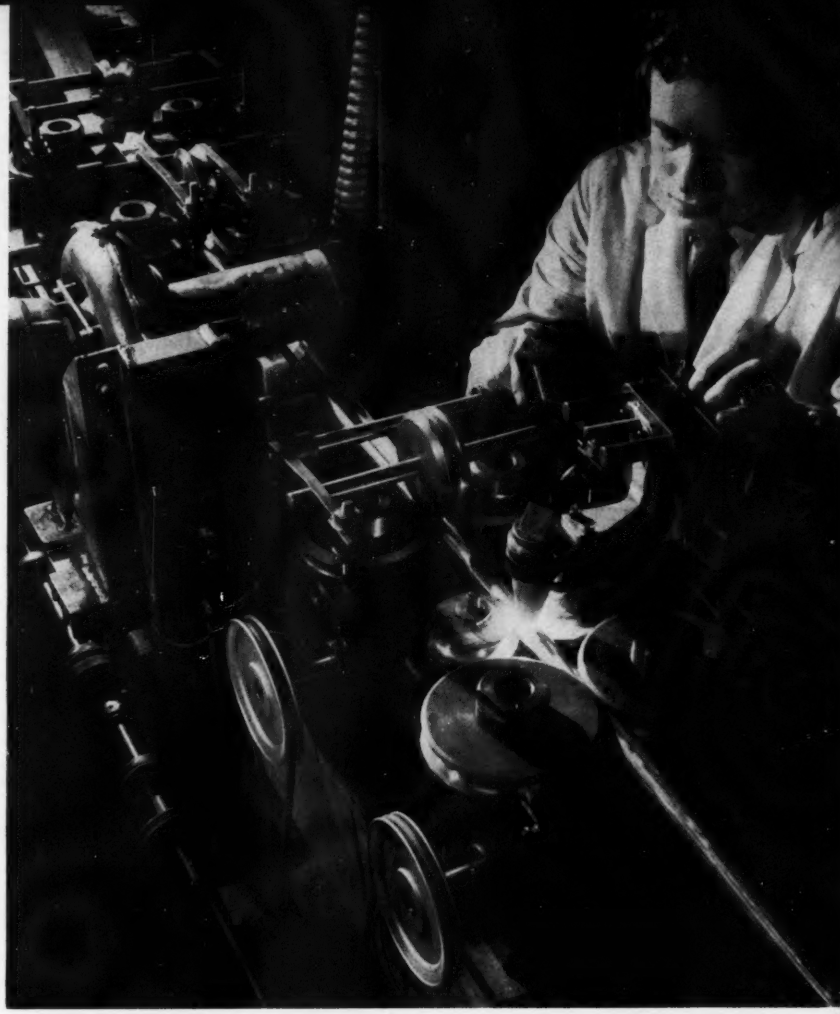
Two of the 'cyclones' of the paste plant, into which atomised aluminium powder is drawn

Research Laboratories

General Electric Co. Ltd. Wembley

By N. L. HARRIS, B.Sc., F.Inst.P.

(Concluded from METAL INDUSTRY, 9 May 1958)



Experimental machine for the forming and twin argon arc welding of aluminium cable sheathing

IN a vacuum device such as a lamp or radio valve the useful life is often influenced by the gas content of its metal components, for the release of gas may spoil the vacuum or contaminate the internal atmosphere or electrodes. If the metal components must be gas-free, it is necessary to determine the gas content of the starting materials and to identify the gaseous constituents themselves, so that complete preliminary degassing may be effected. The gases found in metals divide broadly into those present in the body of the metal (usually hydrogen, oxygen and nitrogen) and those found near or on the surface (often more complex molecules such as water vapour and carbon dioxide). These latter are usually related to the fabrication of the metal component, and to surface contamination and lubricants involved in its mechanical working or shaping. The surface finish of radio valve components, for example, receives particular attention both in the finishing of the metal and the measurement of surface characteristics.

There are cases where a limited and controlled metal gas content is desirable, for example in the manufacture of certain glass-to-metal seals in which the release of gas during the making of the seal provides a cushion of tiny bubbles in the glass which accommodate stresses to which the seal may be subjected.

Studies of the diffusivity properties of individual gases in particular metals assist in the definition of effective degassing procedures. In some devices a knowledge of diffusion rates has been applied to the deliberate maintenance of a low but critical concentration of a simple gas by diffusion from a reservoir through a diaphragm. The temperature of this latter is controlled by the pressure in the main envelope to make the system self-compensating.

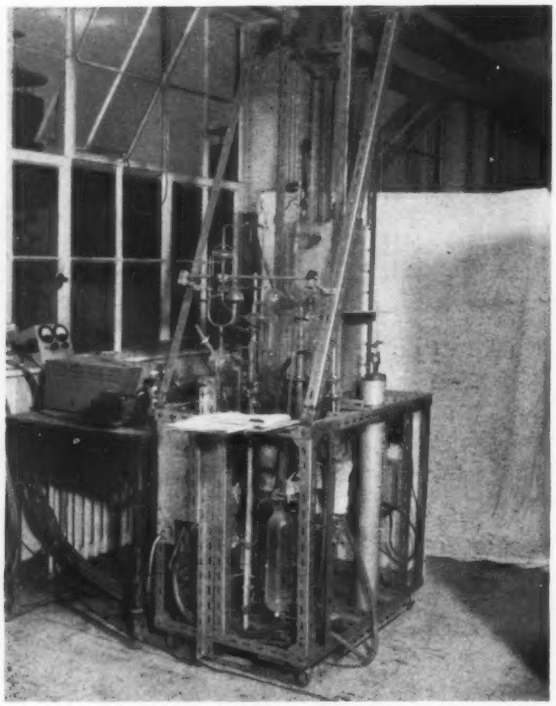
The mechanism of the diffusion of hydrogen through iron is being studied and, in particular, the effect on the solubility in the metal of ionizing the hydrogen. Together with the effects of surface treatment and surface coatings, the results are being applied to the hydrogen permeability of thin-walled iron envelopes.

Controlled Atmospheres

In an entirely different context, the electrical engineering industry as a manufacturer of heat-treatment equipment has been interested for some twenty years in reactions between gases and metals. The successful introduction of electrical heat-treatment furnaces into the metallurgical industry after the first world war provided a basis for subsequent developments of processes in which, for example, the oxidation of a metal charge could be prevented, or the high degree of surface finish of a cold-worked metal product preserved. Subsequent investigations in a very broad field led to the development of economical methods of producing controlled atmospheres, and to the study of reactions between commercial metals and alloys and the gases present in commonly available industrial atmospheres. The combustion, for example, of hydrocarbon gases or charcoal produces complex atmospheres containing components such as carbon monoxide, carbon dioxide, hydrogen, water vapour, nitrogen, and sulphur-bearing gases. The absence of free oxygen does not preclude the formation of heavy scale on metals heated in an atmosphere which includes oxygen-bearing gases. Much work has been done to establish the equilibrium conditions between any one metal and oxidizing and reducing gases, and between steels and carburizing and decarburizing atmospheres, throughout the range of normal heat-treatment temperatures. It is now possible to define atmospheres for the industrial treatment of commercial metals and alloys which will prevent or promote such reactions as oxidation, reduction, nitriding or carburizing, etc.

Industrial and Process Heating

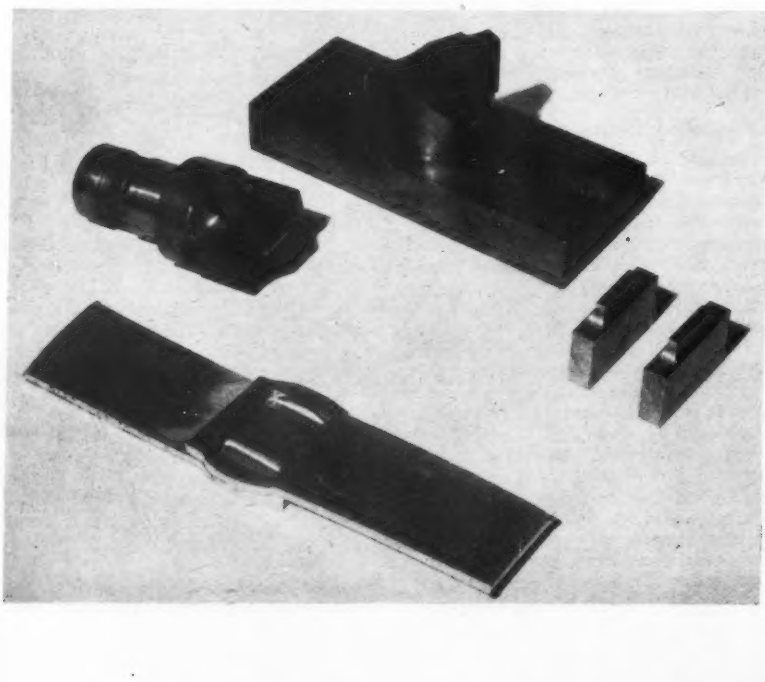
Amongst the varied activities in these fields mention should be made of work on the sintering of chrome-cobalt and other creep-resistant alloys in the 120 kW vacuum furnace, which is also used for the brazing of stainless steel and "Nimonic" components. The furnace uses graphite elements and



Apparatus for measuring the permeation of hydrogen through metals

reaches a temperature of 1,900°C. with a vacuum of 10^{-3} mm. mercury. Brazing and other heat-treatments are also carried out in a 60 kW atmosphere furnace, the most critical operation perhaps being the brazing of stainless steel components in dry hydrogen at up to 1,200°C. An interesting technique has been developed for the hardening of marine crankshafts by a high frequency scanning technique. The shaft is set up in a lathe with a movable head carrying a hairpin-shaped inductor lying close to the crank pin or journal. As the shaft turns, a narrow surface band is heated, and immediately quenched with an oil spray, to produce the hardened surface. Tempering is then performed by re-heating at a lower input power, without subsequent quenching. The operation is controlled by a radiation pyrometer using a small quartz probe and thermopile, specially developed for the purpose.

A lap weld made by the cold welding process. The tools used are shown adjacent to the specimen



Welding

An important development in welding has been the production of continuous aluminium cable sheaths up to 3·75 in. in diameter by an argon arc welding process, after which the sheath is corrugated to grip the cable core and give flexibility for coiling on drums and laying. The quality of the weld must be such that no leak occurs in lengths of many hundreds of yards. This extremely difficult requirement has been achieved by securing very close control of all stages of the operation. Similar techniques are applied to the manufacture of stainless steel sheathed cables up to 1 in. diameter.

The development continues of the techniques of cold-welding aluminium, copper and other metals, invented at the laboratories in 1946. The industrial applications of current interest are the "canning" of transistors and other semi-conductor devices, the butt welding of copper and aluminium cable conductors, and the joining of copper and aluminium sheet and foils to make electrical connections. Precision resistance welding equipment, originally developed for the assembly of many types of thermionic valve, is now being applied to numerous other industrial processes.

Northern Aluminium Co. Ltd: Banbury

—continued from page 406

the company at Banbury and elsewhere, whether it is in the checking of a billet temperature by the operator before extrusion, or the complex system of laboratory control, both in the plant and through specimens delivered from the remelting, heat-treatment or annealing operation. Nor is visual examination confined to the final inspection bay, though here is given the most thorough scrutiny, by old-established methods and also with the aid of ultrasonic equipment.

The final inspection department has been left comparatively unchanged by recent modernization, although its offices have been re-sited and the removal of one badly-lit wall to build the new circle mill bay beyond it has introduced a lightness and airiness that will make for greater efficiency.

Other new buildings have also been erected. The plant and maintenance department has been moved from cramped, but admirably central, quarters adjacent to the sheet mill, and now occupies a site on the east side of the works. This has enabled all maintenance units to be brought under one roof: they are housed in a new aluminium-clad building, which is the largest of several that have been erected, some being used for stores and equipment.

THE EARLY DAYS OF THE INSTITUTE OF METALS

Some Personal Reminiscences

By G. SHAW SCOTT, M.Sc., F.Inst.Met., F.C.I.S.
(Secretary Emeritus, Institute of Metals)

(Concluded from METAL INDUSTRY, 9 *May* 1958)

THE Institute was always most fortunate in the men who made up its council. The interim body that got the Institute going in the summer of 1908 was replaced by a definite elected council at the first Annual General Meeting in 1909. That first council included many famous names in the worlds of metallurgy, engineering and teaching. There was approximately one-third of each on the first and subsequent councils, a proportion approximating to that of the membership of the Institute and one which was carefully maintained throughout the years—it was a scheme of representation believed to be unique among similar scientific societies.

The council, in its early days, had only three committees—the Finance and General Purposes, Journal, and Membership—all, however, vital to the successful functioning and growth of the Institute. Chairmen of the committees made it a useful practice to visit the secretary in his room before the meetings to discuss the latest information as it might affect the agenda items about to be considered in committee. On one memorable occasion the Chairman of the Finance Committee (Professor T. Turner), on concluding this useful preliminary, said "And under 'Other Business' I suppose you have nothing special to bring forward?" "No, Sir," the young and somewhat embarrassed secretary replied, perhaps rather inconsequently, but seeing an apparently good opportunity for putting the question—"Unless I may receive your kind permission to . . er . . marry your daughter!" Congratulations were general a few minutes later in the committee room.

Sir Gerard Muntz was a worthy successor to Sir William White in the Presidential Chair. Essentially a progressive manufacturer with a scientific outlook, his greatest service to the Institute and the industry was the setting-up of the Corrosion Research Committee in 1910. This resulted in the solution of the problem of the causes of corrosion of condenser tubes; but for this the war at sea in 1914-1918 might have been lost. Sir Gerard possessed a bluff, cheery manner. When shown a reproduction of his photograph, to appear in the Journal, he said "Now what have you been up to? I seem to have been sand-blasted!"

I always had an affection for dear old Professor Gowland, the Institute's third President, for he examined me for the B.Sc. and decided I was fit to receive it. He was born as far back as 1842 and in the 1870s was in Japan for many years as Metallurgical Adviser to the Japanese Government. His May Lecture on "The Art of Working Metals in Japan" was a sheer delight. As a Member of the Society of Antiquaries, he used to discuss with me his finds in Silchester—beautiful Roman silver ornaments discovered there were to be seen in his home.

Professor Huntington, the last of the pre-1914 presidents, was forward-looking in many ways, notably as regards aviation and motoring. I often had difficulty in contacting him because he had gone down to the country to make a trip in his balloon or Wright-type aeroplane. He arranged a visit of members to Brooklands in connection with the 1912 London meeting of the Institute, and led a procession of cars round the track in his Wolseley tourer at such a speed that the rest of us had our work cut out to keep up with him and little chance of watching the first demonstration of "looping-the-loop" that was being given over our heads.

The extent of the advance—largely the result of metallurgical research—from that day to this is indicated by an account I have just read in a message from Moscow of "Soviet designs for atomic aircraft able to take an expedition from Moscow to Antarctica in a day."

Having gone the rounds of most of the metallurgical centres of England and Scotland, the Council decided that the time had come for the first foreign Autumn Meeting to be arranged. It happened that in 1913 a great international exhibition was to be held in Ghent—so to Belgium the members went. We had the blessing of the British Government, which carried with it certain diplomatic privileges and ensured a warm welcome from the Belgian authorities. The president, Professor Huntington, desiring to mark the Belgian visit specially in the journal, provided as a frontispiece a photograph that must be unique for such a purpose—"The Copper Dragon de Beffroi, Ghent," a remarkable example of mediaeval metal-working. It is to be seen in Vol. X of the journal.

Sir Henry Oram's Presidency began in March, 1914, and he was soon making plans for the Autumn Meeting to be held at Portsmouth—a very suitable venue bearing in mind that he was Engineer-in-Chief of the Fleet. His letters to me from the Admiralty were notable for their clarity and their terseness—he believed, as did A. J. Balfour, in "half a sheet of notepaper" correspondence. When more might be necessary I was summoned by telephone to his office. I have a characteristic note of his methods in my diary of August 5th, 1914, the day after Britain's declaration of war on Germany. "Spent the whole of this memorable—and wet—day at the Institute. In spite of his tremendous duties at the Admiralty, Sir Henry Oram had time to ring me up and talk about the prospects of the Portsmouth meeting. He ended with the reassuring news that all was well with the British Fleet."

The Institute never held a meeting in Russia—nor even in the United States, though two were planned there and subsequently abandoned by *force majeure*—but most other Central European countries were visited. Relations between the Institute and its many Russian members were curiously negative. There had been no "Corresponding Member to the Council" for that country before the 1914-18 war, after which Colonel N. P. Belaiew, C.B., a White Russian settled in Paris, was appointed to the office. He had many friends in this country and often attended the Institute meetings. After the Bolshevik Revolution in 1917 the new Government made attempts to exchange scientific information with London institutions. I recall putting before the Council batches of metallurgical Papers printed in Russian, with covering letters in English, almost pathetically appealing for the Institute's Papers to be sent in exchange. However, anti-Russian feeling was then so strong that the request was refused, and the Bolshevists were informed that if the journals were required, they could be purchased from the Institute. But this was not the end of the matter. A year or so later, when walking across London Bridge, I saw a Russian ship at a wharf below, from which small but apparently heavy wooden boxes were being taken to a well-guarded motor van; here was gold to buy goods that Russia could not obtain by other means. In due course orders—with cash—came to the Institute for complete sets of journals and for future issues. For many years afterwards the biggest buyer of the journal was the U.S.S.R.

One cannot help wondering, in these days of great scientific achievements by Russia, to what extent these publications, and those of other metallurgical and engineering societies, have influenced the work of Russian scientists in recent years. Today the wheel has come full circle. Russian metallurgical and other technical periodicals come freely into this country. Over 200 are received regularly by the lending library unit of the Department of Scientific and Industrial Research, where more than 500 Russian technical books are available.

INSTITUTE OF METALS GOLDEN JUBILEE MEETING

Major C. J. P. Ball and Miss Ball, Dr. and Mrs. C. J. Smithells, Miss M. Hands

Mrs. W. E. Grey, Mr. and Mrs. E. S. Gandy, Mr. S. G. Gandy, Mrs. I. Dickson

Dr. and Mrs. E. Scheuer, Mr. and Mrs. F. Bacon, Mr. D. Jakobi, Dr. Thomas

Dr. B. Lunn, Dr. and Mrs. F. M. Pinoff

Mr. and Mrs. Bergsman, Prof. Hansen

Mr. and Mrs. P. S. Bryant, Dr. and Mrs. W. T. Pumphrey, Dr, and Mrs. G. L. Miller, Mr. and Mrs. B. E. Berry, Dr. and Mrs. F. G. Cox

Mr. V. S. Booth, Mr. H. J. Goodall, Mr. G. MacWatters, Mr. C. W. Wilmot-Smith

The President, The Lord Tedder and Lady Tedder with Col. and Mrs. W. E. Grey

Mr. R. Cupitt, Mr. A. Flindle, Dr. B. Elliott

Mr. and Mrs. A. R. Raper, Mr. E. R. Perry, Dr. A. G. Ramsey, Prof. F. D. R. Richardson, Mr. F. Dickinson

Finishing Supplement

Institute of Metal Finishing

PROCEEDINGS AT ANNUAL CONFERENCE AT TORQUAY

(Continued from METAL INDUSTRY, *2 May* 1958)

CONTINUING the report of the Institute of Metal Finishing Annual Conference, we publish here Dr. Knapp's reply to the discussion on his Paper. An abstract of the Paper by G. Arnold and the discussion that ensued on its presentation are also appended.

AUTHOR'S REPLY

Dr. B. B. Knapp: Chromium directly on the basis metal has not yet been tried by us, but it is hoped that this will be done in the near future. Not only is it intended to investigate the effect of chromium nearer the basis metal in the middle layer, but also directly on the basis metal. Tin-nickel alloys have not been investigated, although there is probably good hope that they would be advantageous.

Neither has work been done on zinc alloy die-castings, although some results have been seen on these die-castings where the chromium deposit has been investigated. They looked very good. They had not been exposed to actual atmospheric conditions. They were exposed to an accelerated test, and there is always a little danger in trying to determine how accelerated tests are going to perform in service.

On the practical technique of the chromium composite and whether it is any use to-day, we do not know of any actual use of it as such; but we are very much interested in these deposits, so it may not be too long before they are tried out.

Regarding the chosen thickness of 1 mil, we felt that that was at the lower range of thickness used in the automobile industry. It is difficult to draw very definite conclusions from thinner coatings exposed out of doors, since with exposures in the spring, deep cracks may not be seen until the coming winter; whereas in the fall it is only a matter of a few months before cracks are seen.

In reply to Angles, an acid tin bath was used for this work. The flowing was done after the complete deposit was plated, and it was done just above the melting point of the tin. It was simply immersed in an oil bath.

With respect to the technique by which this distribution was obtained, the panels were plated singly in a small bath. The plating cell was used at much the same cross-sectional area as the panel, so that under these conditions there was no build-up at the edges.

The thickness was not measured on the steel panel itself but on a deposit which was plated in parallel on a stainless steel panel. The measurements were actually made by weight of known areas cut through sections of the foil, the strip of stainless steel. This is a very accurate way of checking distribution. The points which were checked were ½ in. from the edge, and the size of the foil measured was ½ in., so half-inches were cut off at various points in the foil.

With respect to thickness, it is true that all the chromium composites were effective in improving the performance of the composite coatings. There was a tendency for the thicknesses in the ranges 5 to 15 micro-in. to show a little better perfection than the other thicknesses, and it may be true that this range gives the minimum porosity for the required chromium bath.

It is known that in this range the maximum protection was obtained when the chromium was placed on the surface of the nickel layer. It may be that the same amount of porosity would be obtained intermediately, although the first layer of nickel in the dull nickel series was not buffed. In other words, the chromium was plated on the as-plated surface of the nickel. It was, however, plated under conditions which normally give rise to a bright deposit.

Work was done by the A.S.T.M. in which they were investigating, amongst other factors, such as cleaning and combinations of copper with nickel and chromium, the effect of copper and nickel for the final coat.

In this work it was found with respect to plating nickel to nickel, especially bulk nickel, that the panel showed very marked improvement in certain atmospheres. These atmospheres were the milder ones, one in the country and another at the sea coast. In the industrial exposure there was no difference in the behaviour of these bulk nickel coatings and a single layer of nickel. What the explanation is was not known. In one case a layer was interposed and put in an acid nickel chloride bath. There was practically no difference between the behaviour of this double metal coating in a marine exposure and a single layer of nickel.

However, in the last programme a very thin layer of nickel plated from this acid nickel chloride bath was interposed. In the milder atmosphere this combination was very much better than a single layer of nickel.

It is difficult to explain. As a result of buffing the first layer of nickel, all the pores have been covered. Therefore, the second layer of nickel is probably more sound, and as a result there are no perforations or corrosion pits, finding a direct path to the basis metal. Consequently, the appearance of rust on the surface is put off. This result was obtained only in a marine atmosphere and in the milder atmosphere, and not in the industrial exposure. There is a marked difference in the corrosiveness of the atmosphere as between the two.

The question came up of the plating of nickel on chromium and whether there was a good sound method for doing so. The one described in the Paper was treatment in an acid nickel chloride bath. This is a bath that operates very low efficiencies. With this treatment excellent adhesion was obtained. There is no indication of any separation between nickel and chromium.

The procedure was simply immersion of the chromium plated article in the bath for 1 min. After that, the work was made cathodic and plated at 1 ft^2/6 min. How critical this time and density are, was not investigated. They are probably not too critical.

Others have found it is not necessary to immerse the coating in this bath for that length of time. They have been able to get good adhesion by separate plating under those conditions.

Regarding crack-free chromium, it did not seem to be the answer to the absolutely continuous interposed metal layer between the two nickel layers. Theoretically, if this is the case there should be complete protection of the basis metal.

The Nickel and Chromium Plating of Steel Iron Covers

By G. ARNOLD.

IN tests designed to ascertain the economies and efficiency of a new plant and processes for plating covers for irons, the covers, which were first emulsion cleaned, were then polished in three operations on backstand idler machines, using 120, 150 and 180 grit bands, with a further lathe operation using a 180 grit emery and "Tripoli" compound on a 10 in. dia. felt bob.

Covers were then degreased in trichloroethylene and loaded on to the cleaning side of the automatic plating machine, which carried out the following operations:—Cathodic clean in hot alkaline solution. Cold rinse. Anodic clean in hot alkaline solution. Cold rinse. Dip in 15 per cent hydrochloric acid. Cold rinse. Copper strike. Cold rinse. Cold rinse. (At this stage the jigs were off-loaded from the automatic plating machine and loaded into the copper plating semi-automatic machine.) Copper plate.

Nominal solution composition, and control: — Rochelle salt, 8 oz/gal.; copper, 4 oz/gal.; sodium hydroxide, 2 oz/gal.; sodium carbonate, 8 oz/gal.; sodium cyanide, 2 oz/gal. Temperature, 160°F. Current density 40 A/ft^2. Plating time, 22·5 min. Average deposit thickness, 0·00035 in. inside cover; 0·0007 in. outside cover.

The plating jig was unloaded and passed by hand through: drag out; cold rinse; hot rinse.

Copper polishing consisted of: Polish sides, nose, and heel of cover, using a 10 in. dia. stitched calico mop with "Tripoli" compound. Wipe off and

colour buff, using an unstitched calico mop.

After copper polishing, covers were trichloroethylene degreased and loaded on to the automatic plating machine, when the first nine operations for cleaning and copper plating were again automatically carried out.

The plating jig was next unloaded by hand and placed in the nickel plating semi-automatic machine.

Nominal solution composition and control for bright nickel plate:—Nickel chloride, 32 oz/gal.; nickel sulphate, 14·5 oz/gal.; boric acid, 6·5 oz/gal.; Brightener "A," 1·25 oz/gal.; Brightener "B," 1 pint/100 gal.; Brightener "C," 1·5 pint /100 gal. *p*H, 3·5. Temperature, 140°F. Current density, 60 amp/ft^2. Plating time, 15 min. Average deposit thickness, 0·00025 in. inside cover; 0·00050 in. outside cover.

The plating jig was passed by hand through: Drag out, cold rinse, and loaded on to the return side of the automatic plating machine for: cold rinse, chromium plate (plating time, 4 min. 40 sec.; average thickness deposit, 0·000015 in.). Nominal solution composition and control: Chromic acid, 50 oz/gal.; sulphuric acid, 0·50 oz/gal.; temperature 100°F.; current density, 80 A/ft^2. Drag out. Cold rinse. Neutralize. Cold rinse. Hot rinse. Jigs were unloaded from the automatic plating machine, the covers removed and passed to inspection and assembly.

The results of the tests showed that when a proportion of the nickel deposit, prior to chromium plating, was replaced by copper, the cost of the materials used was reduced.

When steel pressings plated with nickel-chromium and copper-nickel-chromium were tested, it was found that on the unpolished interior surfaces the use of a composite deposit prior to chromium plating was to be preferred. No difference could, however, be found between surfaces that had been polished prior to chromium plating.

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DISCUSSION

H. C. Castell (The Mond Nickel Co. Ltd.):

Has the introduction of a copper plating sequence and polishing at the copper stage effected maximum reduction in processing costs? There are organic-containing nickel plating solutions in use to-day which confer such a high degree of levelling in either semi-bright or fully bright deposits that some reduction of the initial polishing costs is certainly possible. It is true that Arnold is using a bright nickel solution, but he does not state whether it has levelling properties. If this is so, then surely he is losing some of the advantages of modern nickel plating solutions by introducing copper and polishing this to a high lustre. If, on the other hand, a copper layer is necessary to obtain a high lustre in preparation for his bright nickel, is it really necessary to polish the basis steel to a "180 grit" finish?

Turning now to the relative performances of the two finishes, it is inferred in the conclusions that 0·00035 in. of copper + 0·00025 in. of nickel is superior to 0·00045 in. of nickel, these being the thickness figures on the inside surfaces of the iron covers, but is it fair to draw such a comparison on even 50 parts when tested at different times over a period of six months? The tests, when applied to the outside surfaces of the covers, are clearly too insensitive to determine any difference, since neither all-nickel deposits nor copper-nickel composite deposits showed any corrosion in either the acetic acid-salt spray or the humidity test.

It is, however, fairly firmly established nowadays, with nickel and chromium plated articles in corrosive environments, that one of the most important factors in determining the degree of corrosion protection is the thickness of the nickel deposit, whether or not a copper undercoat is used. This was largely established by a very long and comprehensive series of tests carried out by the A.S.T.M. in a large number of atmospheric corrosion conditions. In this particular case, therefore, a more rigorous and comprehensive test, applied to both types of finish at the same time, would be preferable, when Arnold would probably find that 0·0007 in. copper + 0·0005 in. nickel is considerably inferior to 0·002 in. nickel by itself.

On page 8 of the Paper, Arnold states that when a proportion of the nickel deposit was replaced by copper, the material costs were cut by about half. Is this a justifiable statement when, in fact, the total deposit thickness has been cut by 40 per cent from 0·002 in. to 0·0012 in.? If the costs are compared, when the deposit thicknesses in both methods are the same, the reduction in material costs is 35 per cent.

In other words, if material cost reduction was important, he could have achieved quite a substantial cut, of the order of 20 per cent, by reducing the nickel thickness to 0·0012 in. He would have produced a finish certainly as good as, if not better than, the present nickel-copper composite deposit.

Arnold also implies that the material costs are a very significant part of the total processing costs. It is a pity that these total costs are not shown in greater detail. A slide was shown which indicated that the plating costs were about one-third of the total costs in both processes, but even in this further information he does not show the relationship between the cost of the metal deposited, the material costs, and the total processing costs. When labour, material and overheads are all considered, the material costs in most metal finishing processes represent quite a small proportion of the total.

Dr. S. Wernick (Consultant):

Plant changes should not be based on cost of materials. It happens that just now the price of copper is down and the price of nickel up, but this may be reversed at some time in the future. One should not rush into doing precisely what Arnold suggests on one particular project, as it cannot be generally applied.

D. E. Weimer (M. L. Alkan Ltd.):

Arnold compares the results obtained from using what are essentially basic plating solutions, and under these conditions it is unlikely that either of these systems will produce the optimum results. It does not appear that a cyanide copper solution is available which is suitable for the copper/nickel/chromium system.

One of the major faults with cyanide copper solution is the inability of the anodes to maintain the copper concentration. This has, therefore, to be kept in balance by the addition of cyanide copper, which is a far more expensive way of adding metal than from the anodes. It is not really fair to compare metal costs based on consumption when some of the metal is coming from the addition of salts.

Considerable advantages can be claimed in favour of copper acid sulphate, such as excellent levelling. Acid copper solutions are very variable. The addition agents are relatively expensive and do not overcome the inherent disadvantage of acid copper plating—chemical attack in the recessed areas. This can only be overcome by a relatively thick deposit. A cyanide solution has complex qualities and there is only one adequate solution for copper-plating recessed areas: the pyrophosphate solution.

S. W. Baier (British Non-Ferrous Metals Research Association):

It seems queer that Arnold should claim to find in practice that by reducing what was a 0·002 in. coating of nickel to 0·0003 in. copper and 0·0005 in. bright nickel he gets better results. It seems so contradictory to all that the research work and exposure tests have brought out. Are there some other factors that have not been brought out, such as the loss of weight of metal at important points in polishing, that make this difference?

He has divided his costs much too simply into material costs and labour costs. How can one do this directly, since in changing from dull to bright nickel one has to consider the extra cost of the bright solution, and so on? He is losing a lot of the advantages of the new process. He is using the same polishing with the bright process and not taking any advantage of levelling. He puts so little copper on that it does not seem to be quite the answer to saving the initial polishing cost and doing all the polishing on the copper.

AUTHOR'S REPLY

G. Arnold: Regarding the point about labour cost in the plating shop. The difference is rather great, but the main reason is that the plating shop was originally also used for many other parts used in a variety of products. It is very difficult to engineer a relatively small plating shop to accommodate everything as one requires it.

The obvious comment on the corrosion resistance of nickel deposit is that it is the nickel which contributes to the corrosion resistance. There is, however, one point that seems to have been missed. It is possible that the 0·002 in. deposited on the outside surface may be reduced to as little as 0·0002 in., so it is essential to watch this very carefully. The presence of the copper in the second method greatly assists, because afterwards a nickel plate is put on which gives exactly the protection wanted, as Mr. Castell says. So in the first method it is put on and removed; in the second method it is put on and left there. Generally speaking, therefore, nickel from the second method gives far greater protection.

The thickness of deposit aimed at was one that would give adequate protection. If what is being done at the moment is not satisfying the customer, it will be made thicker. That is the answer.

In reply to Weimer, regarding copper cyanide, as he probably knows, little can be said about the alternative pyrophosphate at the moment.

Industrial News *Home and Overseas*

A Crane Conference

It is said that exports account for a large proportion of the total number of cranes manufactured in this country, and with that fact in mind, **Steels Engineering Ltd.**, makers of the Coles cranes, invited a large number of their agents abroad to a conference at Scarborough with a view to discussing common problems and formulating sales policy for the marketing of the 15 new models with diesel electric transmission now added to their existing range.

The conference proceedings included the delivery of several Papers dealing with the use of cranes in various industries, and films were shown illustrating the manufacture of cranes in the company's own iron and steel and non-ferrous foundries, machine shops, and their welding and fabricating shops. The visitors were shown demonstrations of the Model L 3010, and opportunity was also taken to make reference to the world's largest diesel electric locomotive crane, which has been displayed at the Mechanical Handling Exhibition in London these past few days. This crane has a 125 ft. jib and is intended for use on the site of the Durgapur steelworks in India.

With regard to overseas trade, the visitors were told that until recently some 70 per cent of the firm's output went abroad, the percentage now having fallen to 50 per cent due to increasing local competition. Two cranes had been sold to Russia, but further orders from that country were not anticipated. With this exception, however, the whole world was their market. The company's prices were competitive with those on the Continent, but tariffs ranging from 5 to 30 per cent made sales in some countries difficult. The factory in Western Germany would serve the Common Market area if this is formed.

During their stay at Scarborough, the delegates were able to visit the Mechanical Handling Exhibition, where the company had a number of cranes from their new range displayed. The 53 delegates attending the conference represented firms in 37 countries, but the full total of countries in which the company is interested is 117, some of them served from manufacturing plants in the United States, Australia, and Western Germany. This company has been continuously making cranes for some 80 years and have built up an exceedingly large range of cranes including, they claim, the largest mobile crane in the world.

New Research Centre

Work has now started at Leven, Scotland, on the new research and development laboratories of the **Balfour Group of Companies.** The main objective of this undertaking is to carry out development work for improvement in the design and operation of chemical process plant for many industries, and to widen the application, fabrication techniques, and uses of new materials of construction.

This new centre will also be available to demonstrate the application of existing designs of plant and process methods to clients' materials, to pioneer new processes and techniques, and to carry out work, without obligation, which would not justify the installation of special pilot plant by individual manufacturers themselves. Thus, a confidential laboratory with semi-scale plant facilities will be available as a service, and this should be particularly helpful to small firms.

At this centre will be provided training facilities in every sphere of chemical engineering. A student and graduate apprenticeship scheme has already been launched in conjunction with local technical colleges to enable suitable students, of both sexes, to reach full professional status, and, at the same time, to receive valuable practical training in industry. The whole undertaking is the first stage in the development of a recently purchased 25-acre site which will ultimately contain further fabrication shops and offices.

In addition to a pilot plant bay and a separate pilot plant laboratory, there will be metallurgical, corrosion, physical chemistry, general analytical, and other laboratories. It is expected that the centre will be officially opened in the spring of next year.

A B.B.C. Talk

Great advances have been made during the past year in the application of the electron - microscope to metallurgical problems. It is now possible to check by direct experimental observation of "dislocation" movements, the various theories advanced to account for the plastic properties of metals. Work in this field will be described by Jack Nutting, of the Department of Metallurgy at Cambridge, in a "Science Survey" talk on **"Seeing Through Metals"** on Friday, May 30, in Network Three (Repeat next day at 9.10 a.m. in the Home Service).

An interesting outcome of this work is the demonstration that the properties of thin metal foils differ from those of bulk material, and this may lead to a way of producing metallic components with very different properties from those usually encountered.

Factory Expansion

A new factory now being built in Glasgow will enable **British Oxygen Gases Ltd.** to meet increased demands for their industrial gases in Scotland. A new 25-acre site is in close proximity to the company's existing factory at Polmadie, and a compressing station and stores, together with a liquid oxygen plant, will be erected on the site. Work commenced in March last, and it is anticipated that the buildings will be completed within 12 months.

Light Alloy Water Tanks

Two of the largest light alloy tanks ever made in this country, and believed to be the largest tanks ever prefabricated for marine use, have been built by **Windshields of Worcester Ltd.**, entirely of $\frac{1}{4}$ in. MG5 aluminium alloy plate and extrusions made by **James Booth and Co. Ltd.** These tanks are to hold fresh drinking water aboard two Caltex oil tankers being built in Belgium. The tanks are to be installed topsides, and the use of the MG5 is, therefore, of great importance in saving superstructure weight.

The first of the two tanks to be completed is 18 ft. $\frac{1}{2}$ in. by 13 ft. $9\frac{3}{4}$ in. by 7 ft. $2\frac{1}{4}$ in., and weighs approximately 4 tons. The second tank is 29 ft. $6\frac{3}{8}$ in. by 12 ft. $5\frac{3}{8}$ in. by 5 ft., weighing 4 tons 3 cwt.

The tanks are Argonaut welded throughout, every weld having been subjected to exhaustive tests. Each tank is divided internally into two separate compartments holding 25 tons of drinking water, thus giving each ship storage for

Storage and handling of stainless steel tubes by "Irion" side-operating fork lift carrier at the Walsall works of Talbot Stead Tube Co. Ltd. The illustration below shows the new tube storage area. The manoeuvrability of the "Irion" is strikingly shown—it is turning out of one narrow gangway into another carrying tubes 20 ft. in length

50 tons of water in the new type of tank. The nominal capacity of the tanks is respectively 11,200 gal. and 11,420 gal.

Non-Ferrous Mining

Arranged by the Institution of Mining and Metallurgy in co-operation with the United Kingdom Metal Mining Association, a Symposium on **"The Future of Non-Ferrous Mining in Great Britain and Ireland"** is to be held in London on September 23 and 24 this year at 21 Tothill Street, Westminster, S.W.1, from 10 a.m. to 5 p.m.

The object of the Symposium is to review the mineralized areas and discuss the technical and economic problems affecting their exploration and development; to make an appraisal of the potentialities of the non-ferrous metal industry and to point the way to its revival.

A provisional list of Papers to be presented covers the economic geology of the principal mineralized areas, exploration techniques, the working of existing non-ferrous metal mines, mineral rights, mining taxation, and metal prices.

A Standards Conference

To be opened at Harrogate on June 9 by Sir Roger Duncalfe, the 1958 Assembly of the **International Organization for Standardization** will be attended by some 1,000 delegates. It will be the first occasion on which this triennial conference has been held in Great Britain, and visitors are coming from every one of I.S.O.'s 40 member countries, and the delegates will comprise industrial leaders, engineers, scientists, and other specialists.

The conference will last from June 9 to 21, and headquarters will be at the Royal Hall, Harrogate. There are to be meetings of the various technical committees of the organization, of the I.S.O. Council, and of the full Assembly. The business programme will include visits by delegates to factories and other places of industrial interest in the area, and there will also be a Government reception for the visitors and a banquet, which will be attended by many leaders of British industry who have a special interest in standards work.

Among materials and processes which will be reviewed by standards experts at this conference will be iron and steel, copper and light metals, solid fuels and fuel-using equipment, and machine tools. Arrangements for the whole conference are in the hands of the British Standards Institution, 70 of whose staff will be transferred to Harrogate for the duration of the conference.

News from Paris

The autumn meeting of the Société Française de Métallurgie will be held in Paris from October 20 to 25, 1958. An advanced programme will be issued in July, and full information can be obtained from Société Française de Métallurgie, 25 Rue de Clichy, Paris 9 eme, France.

An Employees' Handbook

Recently introduced into all their factories in this country, **John Dale Ltd.** have produced a handbook for their employees setting out the conditions of employment, rules and regulations, and privileges. In addition to a sickness benefit scheme for employees with ten years' service or more, and long service pay for ten, fifteen and twenty years' service, which is to be paid annually at holiday time, details are also given of a presentation on completion of 25 years' service with the company.

Seventy-three employees with more than 25 years' service, have been presented with gold watches.

Gauge and Tool Makers

On Tuesday last, May 13, Sir William Lyons, managing director of Jaguar Cars Ltd., opened the **Gauge and Tool Exhibition** in the National Hall, Olympia, London. He was received and introduced by Mr. F. W. Halliwell, C.B.E., M.I.Mech.E., President of the Gauge and Tool Makers' Association, which is responsible for the exhibition.

At this exhibition over 60 machine tools may be seen in operation, demonstrating the use of small tools and gauges, and there are also some 25 power presses in action. The exhibition remains open until May 21.

Non-Ferrous Club

Deploring the fluctuations in the price of non-ferrous metals, Mr. Francis B. Willmott, speaking at the monthy luncheon meeting of **The Non-Ferrous Club** in Birmingham last week, drew attention to the difficulties under which industry laboured because of the often extreme variations in the price of its raw materials. Surely, he said, it was not beyond the ingenuity of the metal trade to devise a system which would ensure stability. He threw out a warning that there was a great danger of other more settled value materials being used by manufacturers wherever they could be substituted for non-ferrous metals, and he thought the metal trade should take note of this tendency. Speaking of contracts, as a manufacturer, he said that many large firms, particularly in the automobile industry, repudiated contracts almost as soon as they were drawn up, and this again made manufacturing business scarcely worth while.

Mr. Willmott's views on this aspect of business drew some comments from members of the Club, who pointed out that in the metal trade, although an order might be placed merely over the telephone, that telephone conversation was regarded as a contract and honoured accordingly. Other members asked Mr. Willmott how he would attempt to control metal prices, since this could hardly be done by one country alone, and the question was also asked whether Government control was envisaged. To this, Mr. Willmott replied that he thought Government intervention was deplorable, and that commerce and industry should be left to manage its own affairs.

Following its usual practice of collecting for charity, the sum of £16 10s. 0d. was raised at this meeting on behalf of the Royal Metal Trades Benevolent Association.

Increasing Output

At the Production Exhibition, now open at Olympia in London, the **Mond Mond Nickel Company Limited** has provided an interesting exhibit which has been designed to show the importance of selecting suitable materials for specific problems and thus increasing output. There is a general division into six sections, each of which illustrates at least one aspect of the general theme. The first deals with the properties (and shows specimens) of spheroidal graphite cast iron. Another section deals with metal finishes, including electroless and tin-nickel plating. The physical properties of Mond products are featured, with particular reference to welding applications and in the field of corrosion-resistance.

Finally, an exhibit on the properties and applications of the platinum metals is featured. The exhibit, and the technical publications available on the stand, give a general, and in some cases specific, picture of the properties of Mond products and show how the careful selection of materials can contribute a great deal to modern industry.

Transfer Ladle

For transporting molten metal received from melting unit to casting foundry or elsewhere, and for feeding holding furnaces for die-casting, the **Monometer Manufacturing Co. Ltd.** have produced an hydraulic tilting truck molten metal transfer ladle. This unit is mounted on a truck with wheels fitted with solid rubber tyres and roller bearings. It is light to handle, with ease of movement, and is operated entirely by one man.

From a leaflet issued by the company it is seen that lifting and tilting is by double-action pump operating single hydraulic ram controlled by pump handle, and lowered by operating twist-grip valve control situated on the pump. Lifting of the ladle is adjustable to suit various heights of pouring position of the melting furnaces feeding the ladle.

Capacities of this unit are 200 lb., 300 lb. and 400 lb. (aluminium), for all light alloys and for magnesium alloys; 150 lb., 250 lb., 400 lb. and 600 lb. (brass) for all non-ferrous metals.

At the N.P.L.

From June 4 to 6 next, at the **National Physical Laboratory, Teddington,** a Symposium is to be held on the Physical Chemistry of Metallic Solutions and Intermetallic Compounds. There will be seven sessions, each dealing with the following phases of the subject: experimental methods; metallic solutions; intermetallic compounds; phase transformations; practical applications (this latter occupying the last three sessions).

Complete details of this event may be obtained from the Director, National Physical Laboratory, Teddington, Middx. The registration fee for the Symposium is £2 10s. 0d.

Technical Authorship

A useful pamphlet has just been issued by the **City and Guilds of London Institute** which sets out the regulations and examinations in technical authorship. There is a considerable shortage of competent technical authors, and this scheme of instruction is intended for those with engineering, technical or scientific training and experience, who wish to become technical authors in industry or government service.

The course of training recommended in the pamphlet has been designed with the needs of the younger entrants in mind, but the examinations will also be open to practising technical authors. The Intermediate examination will be offered for the first time in 1960, and the Final examination in 1961. Specimen examination papers will be prepared and issued in the autumn to technical colleges interested in setting up courses.

Copies of this 12-page pamphlet may be obtained from the Institute at Gresham College, Basinghall Street, London, E.C.2, price 9d. including postage.

Refresher Course at Wolverhampton

Some problems of vitreous enamelling were dealt with in a series of Papers presented at the 14th **Ferro Refresher**

Course, held early this month at Wolverhampton College of Technology by Ferro Enamels Ltd.

Among the subjects under review were application techniques, process control, and self mottle ground coats. An interesting aspect of the last mentioned was that it dealt in detail with the nickel dip treatment given to steel sheet prior to enamelling, a process that improves adhesion, especially when the quality of the base material is not of the highest.

A London Meeting

A regular meeting of the **International Wrought Non-Ferrous Metals Council** was held in London on Thursday of last week under the chairmanship of Mr. C. A. Jacobsson, of Sweden. Representatives of copper producers from Belgium, Canada and Rhodesia, and of the Chilean Copper Department, were also present.

Discussion at the meeting centred on increasing the consumption of copper by extending its uses in the consuming industries. The great majority of European users now have national copper development associations of their own, the work of which is co-ordinated by a committee of their own permanent officials. In this way, duplication of work in the various countries can be avoided.

The meeting was also of the opinion that the long-term interests of copper could best be served by leaving the industry free to look after its own affairs, rather than have imposed on it any form of international commodity agreement.

Men and Metals

At the annual meeting of the International Nickel Company of Canada Limited the following retiring directors were re-elected to the board:—**Mr. G. R. Ball; Mr. Lance H. Cooper,** M.B.E.; **Mr. William J. Hutchinson; the Rt. Hon. Lord McGowan,** K.B.E.; **Mr. Donald H. McLaughlin; Sir Otto E. Niemayer,** K.C.B., G.B.E.; **Mr. Ralph D. Parker; Mr. Ellmore C. Patterson; Mr. Laurence S. Rockefeller; Mr. Grant B. Shipley; Mr. R. Ewart Stavert; Mr. J. C. Traphagen,** and **Mr. Henry S. Wingate.**

Technical director of Welding Supervision Limited, **Mr. Colin Bates** has left by air for a four-week tour of Pakistan and the Middle East.

Relinquishing his appointment as Parliamentary Secretary to the Ministry of Labour and National Service, **Mr. Robert Carr,** M.P., M.A., has accepted an invitation from the

board of directors of John Dale Limited to become chairman of their group of companies. Mr. Carr joined John Dale Limited in 1938 and became their metallurgist in 1945, a position he held until 1948 when he was appointed director in charge of research and development. He is a Fellow of the Institute of Metallurgists. The company has also appointed **Mr. J. W. G. Collins** as their assistant managing director. Mr. Collins' association with the company goes back to 1929, and he was made a director in 1956.

Appointments recently made by The British Oxygen Company Limited are as follows:—**Mr. R. C. Hesketh-Jones,** LL.B., formerly sales director of the industrial division of British Oxygen Gases Limited, has been appointed chief executive (Overseas) at the head office of the British Oxygen Company. He is to be succeeded in his former position by **Mr. R. J. Foster,** D.F.C., A.F.C., M.A., who has recently been director and general manager of British Oxygen Aro Equipment Limited. **Captain Q. P. Whitford,** O.B.E., A.M.I.E.E., is taking charge of the aircraft equipment works at Harlow of British Oxygen Engineering Limited.

At the annual general meeting of the Iron and Steel Institute, held recently, it was announced that **H.M. King Badouin,** King of the Belgians, and **H.R.H. Charlotte,** Grand Duchess of Luxembourg, had graciously accepted honorary membership of the Institute. They are both joint patrons of the Institute's special meeting in Belgium and Luxembourg, which is being held next month in conjunction with the Journees Internationales de Siderurgie, being organized in connection with the Brussels World Exhibition.

At a meeting of The Institute of Physics held early this month, the following were elected Fellows of the Institute:—**H. Adam, F. J. Archard, J. J. Benbow, M. M. Bluhm, A. W. Crook, J. Darbyshire, L. R. B. Elton, J. H. Jaffe, E. W. Kellerman, C. N. W. Litting, D. McGill, E. G. Steward,** and **A. N. Stroh.** In addition, 27 graduates, 102 students and five subscribers were elected.

Staff changes and appointments have been recently made by the board of directors of the National Industrial Fuel Efficiency Service as follows:—**Mr. C. A. J. Plummer,** M.Sc., A.R.I.C., to be area engineer in charge of Midland area; **Mr. K. Higginson,** B.Sc., to be area engineer in charge of the North-Eastern area; **Mr. R. Clare,** B.Sc., to be area engineer in charge of the North-Western area; **Mr. L. F. Linnett,** B.Sc., to be area engineer in charge of Northern Ireland, and **Mr. W. Short,** B.Sc., to be area engineer in charge of Wales. The board has also appointed **Mr. George Gill** and **Mr. A. H. Pinder** to be group managers in the northern and southern sections of the country respectively.

Appointed a director and general manager of the new instrument company — Research and Control Instruments Limited — **Mr. R. H. Cooke** played a prominent part in organizing the British exhibit at the first "Atoms for Peace" conference in Geneva. He serves on the committee of the Nucleonics section of the Scientific Instrument Manufacturers' Association, and is also a founder member of the Society of Non-Destructive Testing.

News from Tube Investments Limited is to the effect that **Mr. A. J. S. Aston** and **Mr. R. D. Young** have been appointed to the board of the company. Both of these gentlemen have served the Group for many years in senior executive capacities.

It has been announced by Crofts (Engineers) Limited that **Mr. F. O. Ackroyd,** A.M.I.Mech.E., has been appointed to the board of the company.

Parliamentary News

By Our Lobby Correspondent

Copper Wire Export.—Mr. Douglas Jay (Lab., Battersea, N.) asked the President of the Board of Trade in the Commons what further action he was taking to relax strategic restrictions on the export of copper wire from the United Kingdom to China.

The Minister of State, Board of Trade, Mr. J. K. Vaughan-Morgan, replied that since the beginning of this year, limited quantities of copper wire had been licensed for export to China. The Chinese authorities had been informed that further limited quantities would be authorized in July against firm orders.

Mr. Jay: "From his own industrial experience, does the Minister of State really believe that these restrictions are really necessary?"

Mr. Vaughan-Morgan: "Our only obligation at present to our partners in the Paris Group is to watch how the trade is developing. If, at the end of the review, we consider that no further form of embargo is necessary, we shall, of course, remove our restrictions."

Mr. Hugh Gaitskell (Lab., Leeds, S.): "If it is reasonable to allow limited quantities of copper wire, why should not larger quantities be allowed?"

Mr. Vaughan-Morgan: "If in due course, in July, Mr. Gaitskell puts down a Question, he may find that the 'limited' is not quite so limited."

Forthcoming Meetings

May 19—Institute of Metal Finishing. London Branch. Northampton Polytechnic, St. John Street, London, E.C.1. "Recent Advances in Electrolytic and Chemical Polishing." R. Pinner. 6.15 p.m.

May 20—Institute of Metal Finishing. South-West Branch. Grand Hotel, Bristol. Annual General Meeting. "Electroplating: the Necessary Evil." R. Gillanders. 6.30 p.m.

Metal Market News

PERHAPS the outstanding feature on the bullish side last week was the persistent strength of Wall Street, where quotations advanced almost daily. As to the background of the American economy, there was not much fresh to report, for matters went on very much as before with good news and bad fairly equally mixed. However, it certainly does seem as though the recession in the States were flattening out, with the possibility that later in the year, but perhaps not before the last quarter, there may be a sustained upturn in activity. In this country, business has been overshadowed by the continuation of the bus strike and the threat of an imminent stoppage on the railways. Apart from this, there are other demands pending for shorter hours and increased wages which can hardly fail to be reflected in a weakening of the pound. Of the four non-ferrous metals traded in Whittington Avenue, tin was outstanding for a substantial advance in value, most of which took place during the second half of the week. Warehouse stocks were reported 934 tons up at 18,614 tons, or more than 400 tons higher than the copper tonnage which, at 18,207 tons, showed a decline of 750 tons. Closing firm, the tin market registered a rise of £6 in cash and of £7 in three months, the quotations last Friday afternoon being £737 cash and £741 three months. At long last it appears that the United States is buying some tin, and the firmer tone probably caused some hasty bear covering. The turnover was about 825 tons.

As already mentioned, there was a decline in stocks of copper in official warehouses, but this did not appear to affect the contango which, on Friday afternoon last, stood at 35s., the close being £179 cash and £180 15s. 0d. three months. The turnover without the inclusion of Kerb dealing amounted to about 7,150 tons, a figure rather below average. On the New York commodity exchange business continues to be fairly active but there is not the exceptional turnover that characterized this market a few weeks ago. On balance, cash fell by £1 and three months by 15s., the contango widening by 5s. Following the meeting between the producers and consumers last Thursday, May 8, a brief statement was issued which, it must be confessed, did not contain anything novel or exciting. It may be presumed that the question of the L.M.E. standard copper contract came up for discussion, but no comment has been made. Probably by now it is pretty generally accepted that the chances of any alteration being made in the contract at the present time are fairly remote.

Both zinc and lead moved within fairly narrow limits, but the tone was rather easier and on balance losses were registered. In lead, the turnover was 3,150 tons, May closing 15s. down at £72 15s. 0d., while August lost 12s. 6d. at £72 17s. 6d. Zinc was rather more active, for about 4,500 tons changed hands with a loss of £1 in May and of 15s. in August, the respective closing quotations being £62 7s. 6d. and £62 15s. 0d. Although these two metals keep pretty steady, the outlook is not particularly bright, for there is a fixed determination to protect the American market, and that means selling pressure in Whittington Avenue. As to copper, the same remarks apply, and it can hardly be doubted that a protective tariff at the rate of 1·7 cents per lb. will be applied on July 1 next. As to the plan for subsidizing the U.S. producers, that may or may not go through in due course, but it is going to take time, and in the meanwhile wiser counsels may prevail.

Birmingham

As a result of a labour dispute at a works outside Birmingham which makes car bodies, four or five thousand men have been idle in the car factories this week, and many more are threatened with unemployment unless there is an early settlement. Apart from this disturbance, the industrial position is fairly steady, although the number of workless over the area is increasing slowly. Users of raw materials are buying cautiously because of the general feeling of uncertainty. Export business is more difficult to secure, but manufacturers are sparing no effort to cultivate overseas trade. A new export drive has, in fact, been launched by the National Union of Manufacturers. Its Midland branch is inaugurating an exports advisory service especially to help the smaller firms who have less experience of this class of business.

Activity in the steel industry is highest in regard to heavy plates, and the plate mills are likely to be busy over the next few months on existing contracts. Other products are not being called for to the same extent and forward business is particularly quiet. There is a good market for sheet for the motor trade, and a number of foundries are busy on castings for motor work. Several of the re-rolling mills are on short time through lack of orders. Slackness is reported in the machine tool trade.

New York

The U.S. non-ferrous metal market was featureless throughout the past week. The Administration's mineral subsidy plan to support prices of lead, zinc, copper, tungsten and fluorspar came in for critical comment by leading non-ferrous metal executives and no leading industry figure supported the plan.

In custom smelter copper, smelters reported a fair amount of business at 23¾ cents per lb., but as the week progressed even their sales dwindled. Producer copper at 25 cents per lb. continued to move slowly.

Lead and zinc were slow of sale, while tin moved in a narrow range with the International Tin Council's decision to continue export quotas throughout the third quarter not unexpected.

The Secretary of the Interior, Mr. Fred A. Seaton, who put forward the subsidy plan as a substitute for tariff increases, is due to disclose further details of the programme in the near future to Congress. Mr. Seaton disputed the views of some industry executives that the net result could be price cuts by U.S. mines, who would have the United States Government make up the difference between their price and the subsidy price of 27½ cents per lb. Copper, lead and zinc producers, as well as brass manufacturers, had stated that higher import tariffs and a quota system were the most workable answers to the depression in domestic non-ferrous metals.

Brass mills reported that their business was still in the doldrums and that April shipments were behind those of March.

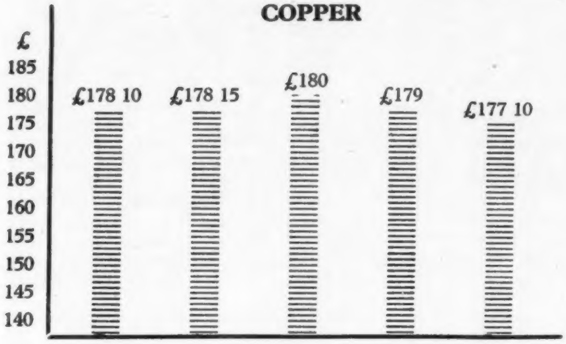
The American Bureau of Metal Statistics reported that receipts of lead in ore and scrap by U.S. smelters amounted to 44,927 tons in March, against 42,373 tons in February.

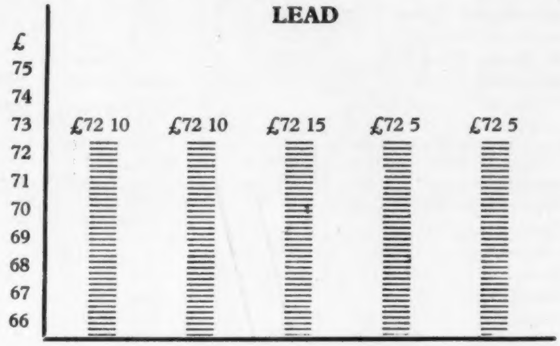
Secondary tin recovered by detinning plants, as metal and in chemical compounds, remained virtually unchanged in 1957, according to the Bureau of Mines, United States Department of the Interior. The total tin recovered was 4,100 short tons in 1957, and 4,170 in 1956. Tin plate clippings and old cans were the source of 3,750 tons in 1957, 3,180 tons of which was reclaimed as metal and 570 tons in the form of tin compounds. In 1956 such materials provided 3,800 tons of tin, 3,020 tons as metal and 780 tons in compounds. The treatment of other tin-bearing materials accounted for the remaining production.

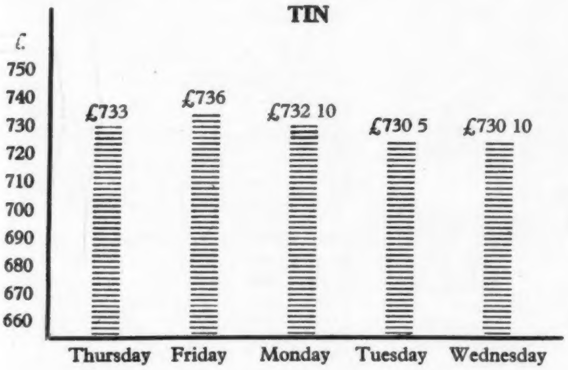
Leading refiners at the end of last week finally reduced their official price rate for platinum by 5 dollars to 67 dollars an ounce in bulk and 70 dollars in smaller quantities. The previously published price range had been 72-75 dollars since February 14 last. Outside market dealers, however, have been, and still are, offering fair-sized amounts of the metal as low as 65 dollars an ounce.

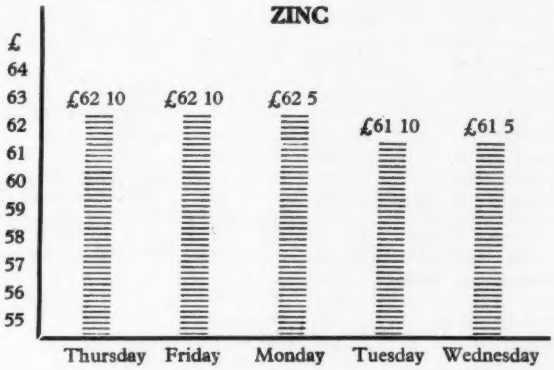
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 8 May 1958 to Wednesday 14 May 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏ £/ton	Canada c/lb	≏ £/ton	France fr/kg	≏ £/ton	Italy lire/kg	≏ £/ton	Switzerland fr/kg	≏ £/ton	United States c/lb	≏ £/ton
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.10	208 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0	2,550	1,479 0			155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							375	217 10				
Electrolytic	25.25	184 10	24.25	200 7 6	230	200 2 6			2.30	192 7 6	25.00	200 0
Lead			11.25	93 0	114	99 2 6	183	106 2 6	.93	77 15	12.00	96 0
Magnesium												
Nickel			71.50	590 10			1,330	771 10	7.80	652 5	74.00	592 0
Tin	102.75	751 2 6			908	790 0	1,400	812 0	8.70	727 10	95.50	764 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	158	91 12 6	.82	68 10	11.25	90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 14/5/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite per unit			—	
Copper H.C. Electro	ton	177	10	0
Fire Refined 99·70%	„	176	0	0
Fire Refined 99·50%	„	175	0	0
Copper Sulphate	„	66	0	0
Germanium	grm.		—	
Gold	oz.	12	9	5
Indium	„		10	0
Iridium	„	26	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	5	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	76	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum	„	25	0	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4⅛
Tellurium	lb.		15	0
Tin	ton	730	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	61	10	0
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	86	10	0
Granulated 99·99+%	„	99	3	9

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	155	0	0
B.S. 1490 L.M.2	„	161	10	0
B.S. 1490 L.M.4	„	182	10	0
B.S. 1490 L.M.6	„	204	10	0

†Average selling prices for February

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton		—	
BSS 1400 AB.2	„	209	0	0
***Brass**				
BSS 1400-B3 65/35	„	129	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	155	0	0
(86/7/5/2)	„	165	0	0
(88/10/2/1)	„	214	0	0
(88/10/2/½)	„	224	0	0
Manganese Bronze				
BSS 1400 HTB1	„	169	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	240	0	0
Phosphor Copper				
10%	„	213	0	0
15%	„	221	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	345	3	0
Grade D Plumbers	„	279	3	0
Grade M	„	378	3	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	92	8	9
Mazak V	„	96	8	9
Kayem	„	102	8	9
Kayem II	„	108	8	9
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0¼
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10¼
Strip 10 S.W.G.	„		3	0¼
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M.				
Plate as rolled			2	10¼
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6¼
Sheet 18 S.W.G.	„		4	0¼
Sheet 24 S.W.G.	„		4	10¼
Strip 10 S.W.G.	„		3	9¼
Strip 18 S.W.G.	„		4	0¼
Strip 24 S.W.G.	„		4	8¼
BS1477. HPC15WP.				
Plate heat treated	„		3	5¼
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	9¼
BS1471. HT10WP				
Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP.				
Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	5⅞
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„		—	
Extruded Bar	lb.		1	8½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	147	0	0
Condenser Plate (Naval Brass)	„	158	0	0
Wire	lb.		2	3½
Copper Tubes	lb.		1	8⅞
Sheet	ton	205	10	0
Strip	„	205	10	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	229	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	2⅞
Lead Pipes (London)	ton	115	5	0
Sheets (London)	„	113	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3
Wire 10%	„		3	9¾
Phosphor Bronze				
Wire	„		3	6½
Titanium (10,000 lb. lots)				
Billet 11″-4″	lb.	69/-	60/-	
Wire ·315″-·036″	„	101/-	201/-	
Sheet (4′/8′×2′) ·160″-·010″	„	100/-	158/-	
Strip ·048″-·003″	„	100/-	350/-	
Tube Representative gauge	„	320/-		
Extrusions	„	137/-		
Zinc Sheets, English destinations	ton	96	0	0
Strip	„	nom.		

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Feb., 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	2,557
Imports	11,249
Despatches to consumers	16,804
Secondary Aluminium	
Production	9,601
Virgin content of above	1,296
Despatches (including virgin content)	9,379
Secondary in Consumption (per cent)	
Wrought products	5·6
Cast products	79·9
Destructive uses (aluminium content irrecoverable)	65·4
Total consumption	29·0
Scrap	
Arisings	11,046
Estimated quantity of metal recoverable	7,800
Consumption by:	
(a) Secondary smelters	10,782
(b) Other users	1,071
Despatches of wrought and cast products	
Sheet, strip and circles	10,423
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,421
(b) Tubes (i) extruded	284
(ii) cold drawn	392
(c) (i) Wire	1,345
(ii) Hot rolled rod (not included in (c) (i)	512
Forgings	298
Castings: (a) Sand	1,681
(b) Gravity die	3,859
(c) Pressure die	1,382
Foil	1,910
Paste	179
Magnesium Fabrication	
Sheet and strip	9
Extrusions	43
Castings	179
Forgings	3

LIGHT METALS STATISTICS IN JAPAN

(January, 1958)

Classification	Production	Shipment	Stock	Export
Alumina	11,943	13,029	14,266	0
Aluminium				
Primary	5,432	5,863	3,270	554
Secondary	1,624	1,638	296	0
Rolled Products	5,125	4,976	1,574	627
Electric Wire	1,315	729	1,652	78
Sheet Products	1,292	1,376	911	54
Castings	1,502	—	—	—
Die-Castings	875	—	—	—
Forgings	12	—	—	—
Powder	—	—	—	—
Primary Aluminium (February)	5,169	5,981	2,458	666
Sponge Titanium	151	—	—	139
Magnesium	67	62	9	0
Secondary	223	171	202	0

Albright and Wilson Ltd.

Group trading profit for the year 1957 £4,754,000 (£4,416,000); net profit after depreciation, taxation and minority interests £1,553,000 (£1,203,000). Dividend 20 per cent (18 per cent).

British Chrome and Chemicals

For the year ended December 31, 1957, the accounts of British Chrome and Chemicals (Holdings) Ltd. show net profit of the group, after taxation, of £403,342 (£421,313). Balance carried forward—to parent company £113,611; to subsidiary companies £45,774. Dividends on the Ordinary stock totalling 12½ per cent (same) less tax, have already been declared.

Edwards High Vacuum Ltd.

Group net profit for 1957, £76,458 (£85,039) and dividend 15 per cent (same). Current assets £1,034,227 (£983,900), including cash £2,532 (£2,856). Current liabilities £343,311 (£321,560), including bank overdraft £64,340 (£40,124). Reserves £217,350 (£177,302) and future tax £77,500 (£70,500).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Hampstead Aluminium Turners Ltd. (600987), 36 Southampton Street, W.C.2. Registered March 21, 1958. Nominal capital, £5,000 in £1 shares. To take over business of engineers and manufacturers of irrigation equipment carried on by Laston Ltd., etc. Directors: Ludwig Blass, Walter Blowers and Benjamin Hill.

Kay and Company (Engineers) Limited (600991), Bolton Brass Works, Blackhorse Street, Bolton. Registered March 21, 1958. To take over business of Alenco Ltd., and to carry on business of brass, bronze and iron founders, etc. Nominal capital, £100 in £1 shares. Directors not named.

George S. Tye and Co. Ltd. (601269), 120 Branston Street, Birmingham, 18. Registered March 26, 1958. To carry on business of manufacturers of metal smallwares, etc. Nominal capital, £5,000 in £1 shares. Directors: Geoffrey L. Ward, Philip J. Ward, Mrs. V. M. Ward and Mrs. E. B. Ward.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 13/5/58.

	£
Aluminium	
New Cuttings	143
Old Rolled	120
Segregated Turnings	89
Brass	
Cuttings	115
Rod Ends	112
Heavy Yellow	98
Light	93
Rolled	107
Collected Scrap	95
Turnings	106
Copper	
Wire	156
Firebox, cut up	156
Heavy	149
Light	144
Cuttings	156
Turnings	141
Braziery	123

	£
Gunmetal	
Gear Wheels	152
Admiralty	152
Commercial	128
Turnings	123
Lead	
Scrap	64
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	128
Turnings	123
Zinc	
Remelted	53
Cuttings	40
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£156.12.6)	180
Heavy copper	(£152.5.0)	175
Light copper	(£130.10.0)	150
Heavy brass	(£100.0.0)	115
Light brass	(£69.12.6)	80
Soft lead scrap	(£57.10.0)	66
Zinc scrap	(£39.2.6)	45
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£193.2.6)	222
Heavy copper	(£193.2.6)	222
Light brass	(£143.10.0)	165
Zinc castings	(£67.0.0)	77
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£130.10.0)	150

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£188.10.0)	325
Aluminium copper alloy	(£101.10.0)	175
Lead, soft, first quality	(£84.2.6)	145
Lead, battery plates	(£49.7.6)	85
Copper, first grade	(£174.0.0)	300
Copper, second grade	(£162.10.0)	280
Bronze, first quality machinery	(£177.0.0)	305
Bronze, commercial gunmetal	(£148.0.0)	255
Brass, heavy	(£124.15.0)	215
Brass, light	(£113.2.6)	195
Brass, bar turnings	(£121.17.6)	210
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

THE STOCK EXCHANGE

Industrials Finished The Account Rather Dull And Heavy In Tone

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 13 MAY	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	20/6	+3d.	10	10	9 15 0	20/6	17/9	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/6xd		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	48/3	—1/3	15	15	6 4 6	51/-	47/-	72/3	47/9
1,590,000	1	Birfield Industries	48/3	—1/1½	15	20N	6 4 6	53/9	48/3	70/-	48/9
3,196,667	1	Birmid Industries	60/9	—1/9	17½	17½	5 15 3	65/6	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	28/6	—6d.	10	8	7 0 3	28/6	23/9	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½		6	6	7 4 3	17/-	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	26/3	—7½d.	12½	12½	9 10 6	28/9	26/3	30/3	28/9
300,000	1	Ditto Pref. 5%	15/3	—9d.	5	5	6 11 3	16/-	15/3	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/3		7	7	7 5 6	19/3	19/-	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	37/-	—2/6	12	12	6 9 9	46/6	37/-	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/-		6	6	6 6 3	19/3	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/6	—1/9	12½	12½	5 17 6	44/3	38/10½	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	32/3	—1/3	10	10	6 4 0	35/3	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	19/10½	+1½d.	25+*2½C	25	6 5 9	21/-	19/10½	24/6	19/3
60,484	1/-	Carr (Chas.)	2/1½		25	25	X8 4 9	2/3	2/-	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/4½	—1½d.	25	25	11 8 6	4/9	4/4½	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	17/-	+3d.	10	10	11 15 3	17/-	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/-
250,000	2/-	Coley Metals	3/9	+3d.	25	25	13 6 9	4/6	3/3	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	45/6	—3d.	18¾	22½	8 4 9	51/6	43/-	92/6	49/-
1,136,233	1	Davy & United	48/9		15	12½	6 3 0	48/9	45/9	60/6	42/6
2,750,000	5/-	Delta Metal	17/7½	—3d.	30	*17½	8 10 3	21/4½	17/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	30/6	—1/-	12½	15B	8 4 0	33/-	24/-	38/6	25/-
750,000	1	Evered & Co.	28/-xcap		15	15	7 2 9	28/-	26/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	30/6	—1/3	12½	14	Y7 10 9	38/7½	29/6	59/-	38/-
1,250,000	Stk. (10/-)	General Refractories Ltd.	32/-	—6d.	20	17½	6 5 0	33/9	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/-		15	15	4 12 3	66/3	64/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	6/3	+3d.	11½	11½	9 4 0	6/3	5/7½	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	13/4½		20	20	7 9 6	13/6	12/10½	18/-	12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	21/4½	—7½d.	18Z	16	5 12 3	22/1½	19/3	37/3	28/9
342,195	1	Greenwood & Batley	46/9		17½	17½	7 9 9	46/10½	45/-	50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	12/1½		*15	*15	6 3 9	12/4½	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	—		22/3	18/7½
1,075,167	5/-	Heenan Group	7/3		10	20‡	6 18 0	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	43/9		12Z	10	5 9 9	44/10½	36/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/3	—3d.	5	5	6 3 0	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	137	+1½	$3.75	$3.75	4 18 0	144½	134	222	130
430,000	5/-	Jenks (E. P.), Ltd.	7/9	+3d.	27½ ɸ	27½	8 17 6	7/9¾	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/-	17/-	14/6
3,987,435	1	Ditto Ord.	44/-	—6d.	10	9	4 11 0	44/6	37/6	58/9	40/-
600,000	10/-	Keith, Blackman	16/3		15	15	9 4 6	‖16/3	15/-	21/9	15/-
160,000	4/-	London Aluminium	3/-	—1½d.	10	10	13 6 9	4/3	3/-	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	42/-	—6d.	12½	12½	5 19 0	43/9	39/9	54/6	41/-
400,000	1	Ditto Pref.	22/3		7½	7½	6 14 9	22/9	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	32/6		15	15	9 4 6	35/-	32/6	48/9	37/6
1,530,024	1	Ditto A Ord.	31/3		15	15	9 12 0	32/6	30/-	47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	10/-	—6d.	20	27½‡	10 0 0	10/6	9/-	21/10½	7/6
50,628	6/-	Ditto (7½% N.C. Pref.)	6/3		7½	7½	7 4 0	6/3	5/9	6/6	5/-
13,098,855	Stk. (£1)	Metal Box	48/6	+1/-	20‡	15M	4 2 6	48/6	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	6/10½		50	50	14 11 0	6/10½	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	21/9		10	10	9 4 0	22/9	21/9	25/-	21/6
80,000	5	Ditto Pref. 6%	81/6		6	6	7 7 6	83/6	81/6	90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	39/-		10	11	5 2 6	40/-	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/-		5½	5½	6 9 6	17/3	17/-	19/3	16/-
2,200,000	Stk. (£1)	Murex	54/3	+3d.	20	20	7 7 6	57/6	53/3	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	7/3		10	10	6 18 0	7/3	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	27/-		27½D	27½	6 15 9	27/-	26/-	41/-	24/9
1,365,000	Stk. (5/-)	Serck	12/1½	—1½d.	17½Z	15	4 16 3	12/4½	11/-	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9		16	16	7 6 6	—		57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/-	—9d.	6½	6½	6 10 0	20/9	20/-	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	51/9	+4½d.	15	15	5 16 0	54/6	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	30/7½	—10½d.	10	10	6 10 6	32/6	29/4½	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/-		5	5	6 13 3	15/6	14/9	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/6		*5	*5	7 3 6A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	73/3	—1/6	20	15	5 9 3	76/3	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	37/9	—3d.	10	18P	5 6 0	38/-	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	7/6	—3d.	25	40	6 13 3	8/-	7/2½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	17/3	—1/-	27½	27½	7 19 6	17/7½	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6		20	17½E	14 5 9	3/9¾	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		40D	33⅓	9 5 6	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11¼% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ɸ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.